

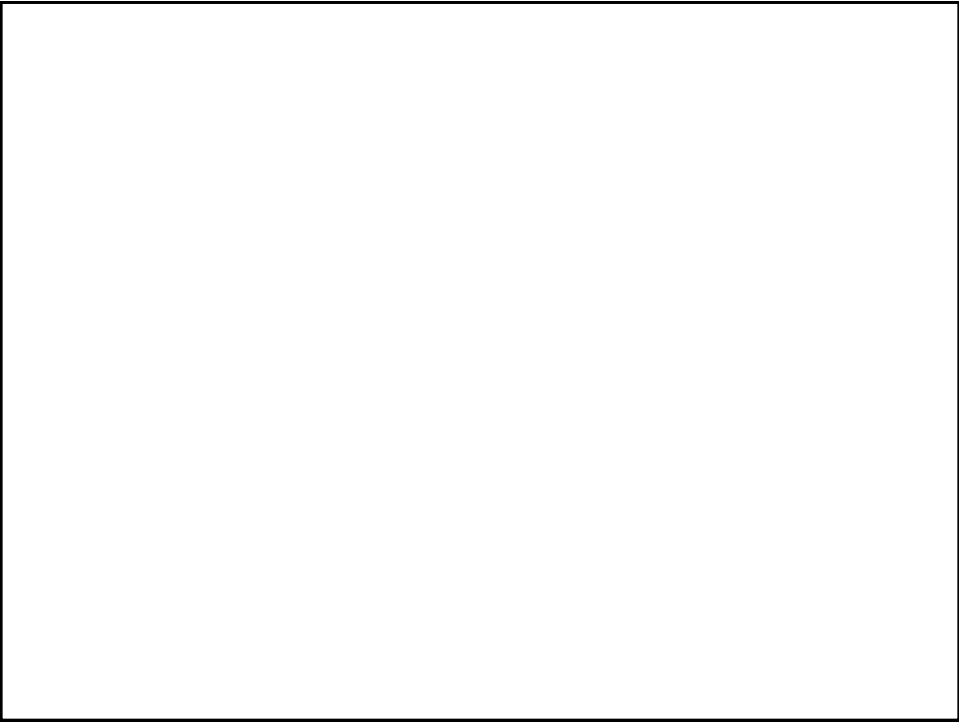
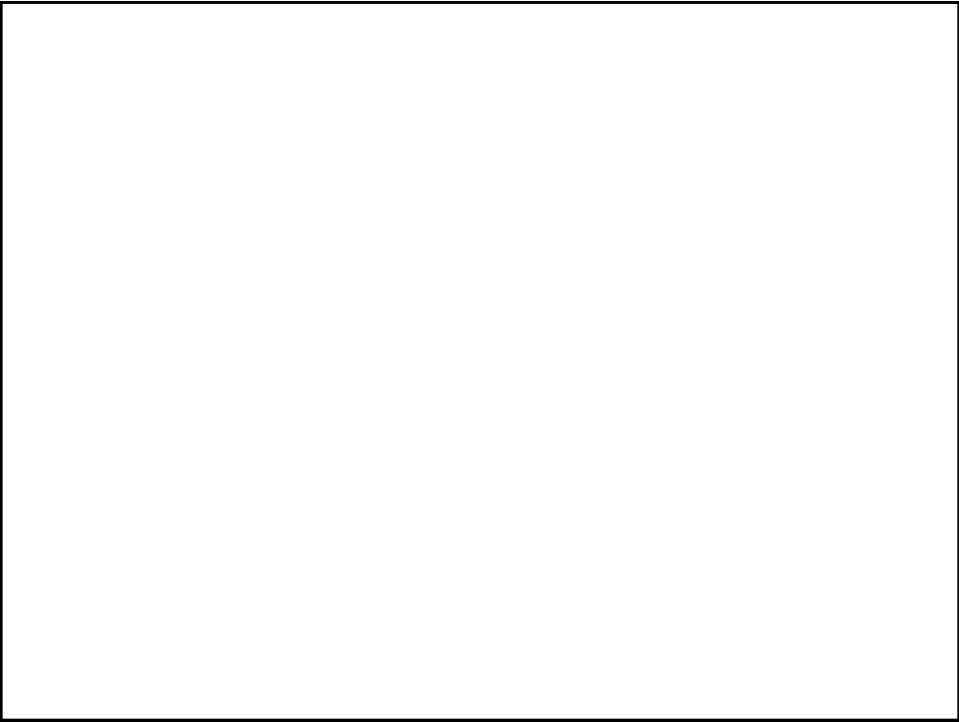
Unit 2

Part 3

Homeostasis: Processes requiring energy to form responses

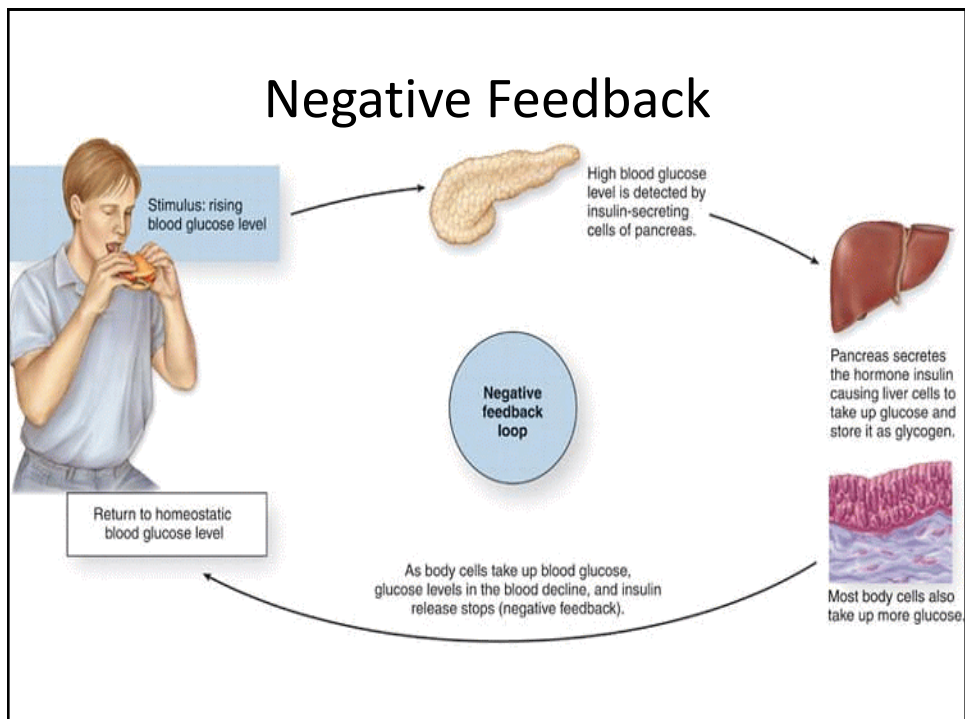
AP Biology

Ms. Passamonti

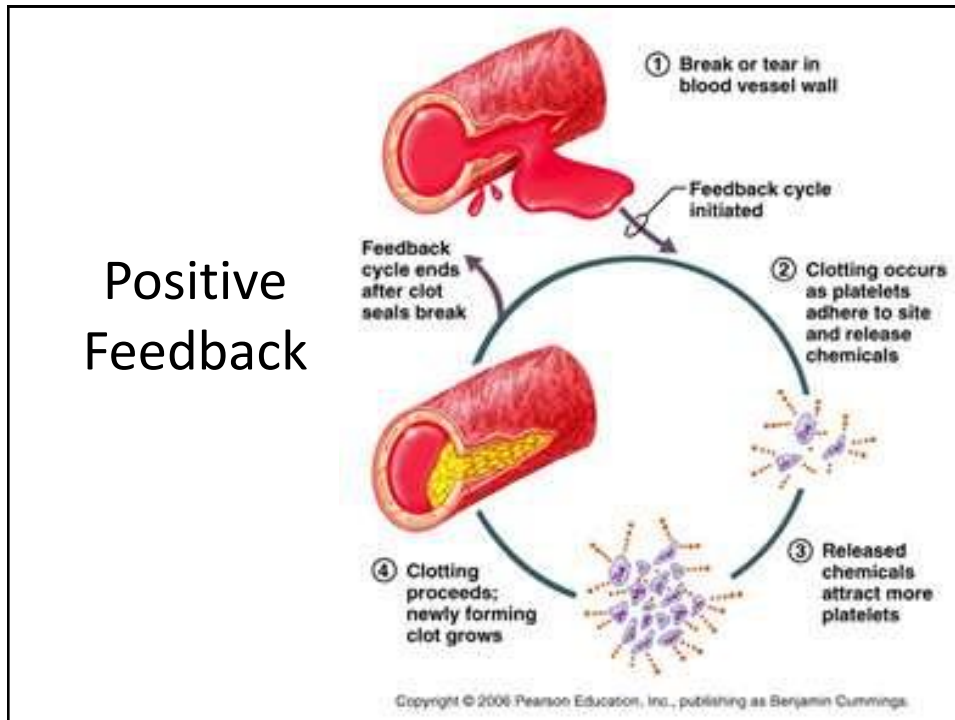


Feedback Mechanisms

- Organisms use feedback mechanisms to maintain their internal environments and respond to external environmental changes.
- Negative Feedback
- Positive Feedback



Positive Feedback



Feedback Disruption Consequences

- Diabetes
- Low blood clotting, bleeding to death

Disruptions

- All biological **systems** are affected by disruptions to their dynamic homeostasis
 - Organism dehydration
 - Immune responses to pathogens
 - Invasive species
 - Hurricanes, Floods, Volcanoes

Common Ancestry

- Homeostatic mechanisms reflect both common ancestry and divergence due to adaptation in different environments.
 - Respiratory systems on land & in water
 - Digestive mechanisms in animals
 - Excretory systems
 - Osmoregulation

Nitrogenous Wastes

1. Ammonia: Very toxic, must not be stored for long

aquatic animals can excrete ammonia since the surrounding water dilutes it quickly.



Nitrogenous Wastes

2. Urea: Less toxic so it can be stored for longer

mammals

Ammonia metabolized with CO_2 by the liver = costs energy!



Types of Homeostatic Responses

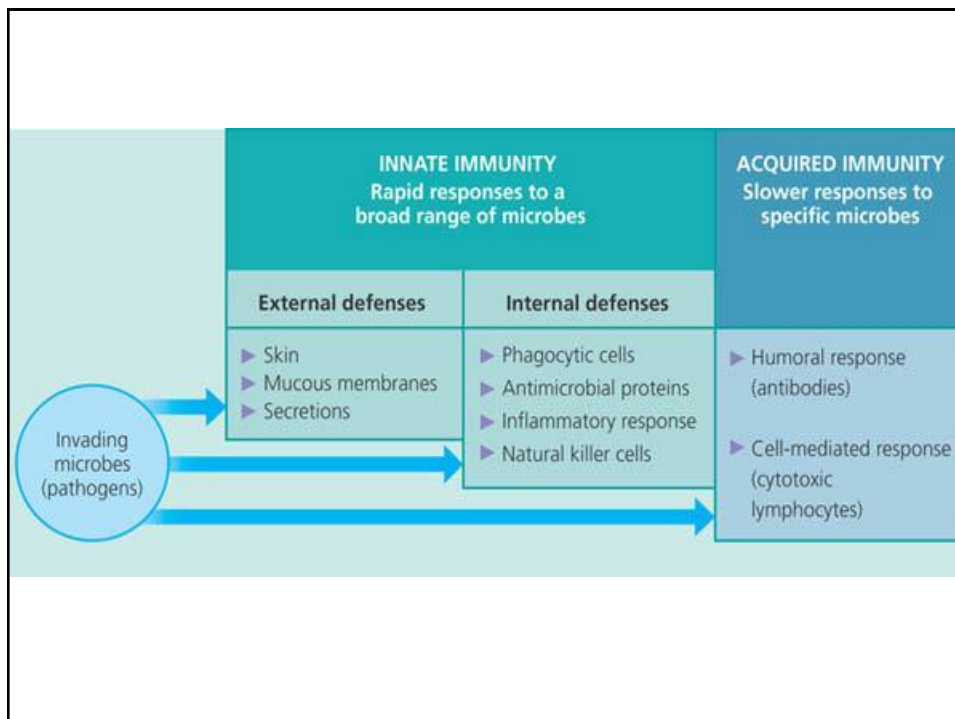
- Behavioral
 - Nocturnal activity
 - Hibernation
- Physiological
 - Immune responses
 - Shivering
 - Sweating
 - Phototropism

Chemical Defenses

- Plants & Animals have a variety of chemical defenses against infections that would otherwise affect homeostasis
- Plants, invertebrates & vertebrates have many non-specific immune responses

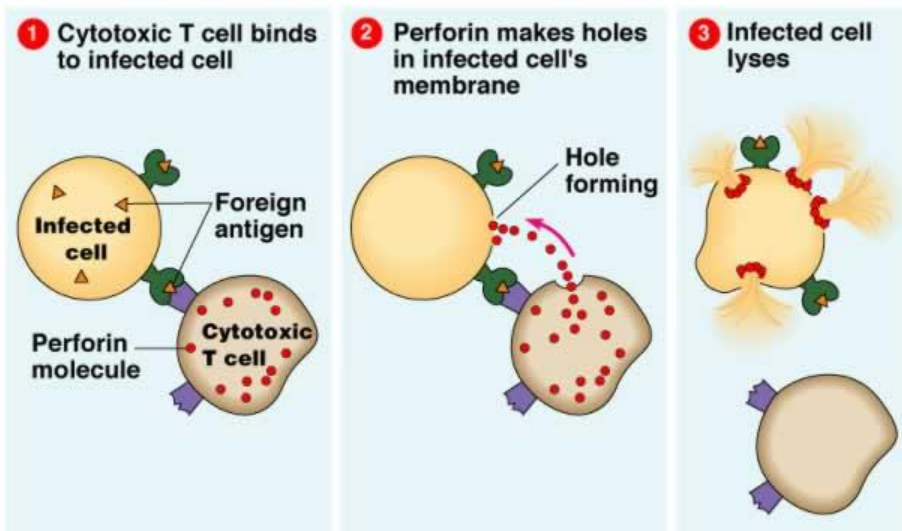
Mammalian Immunity

- Mammals use non-specific & specific immune responses
- Specific: Target specific pathogens
- Non-specific: target nearly any invader



2 Types of Specific Immunity

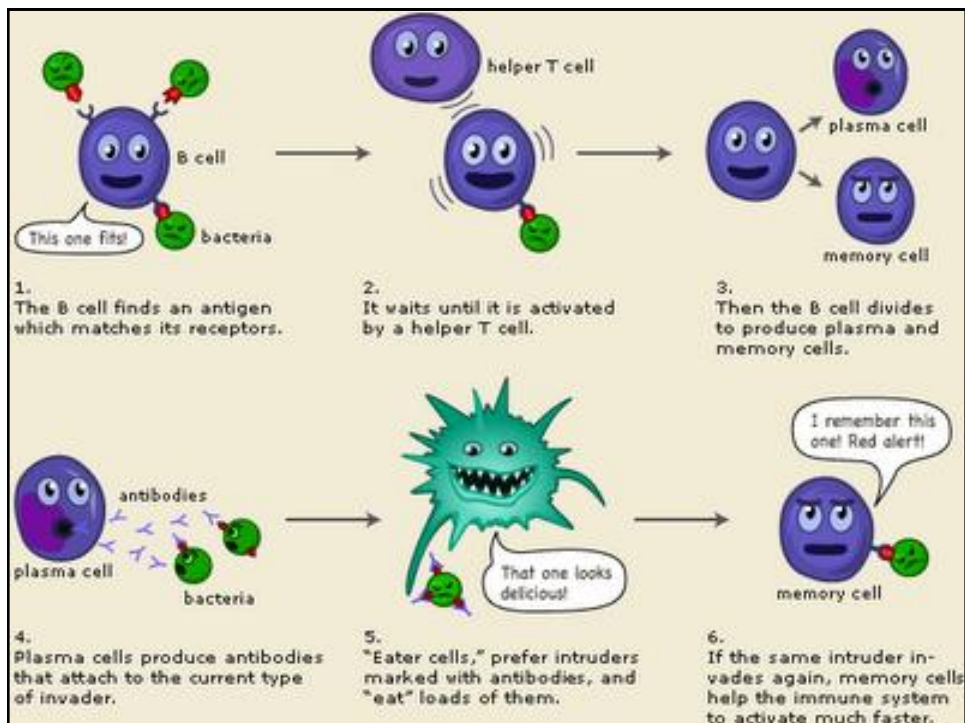
- 1. Cell-Mediated Response
 - Cytotoxic T cells (White Blood Cell type!)
 - Target intracellular pathogens
 - Signaled by antigens (anything that acts as a signal to “non-self” by immune cells)

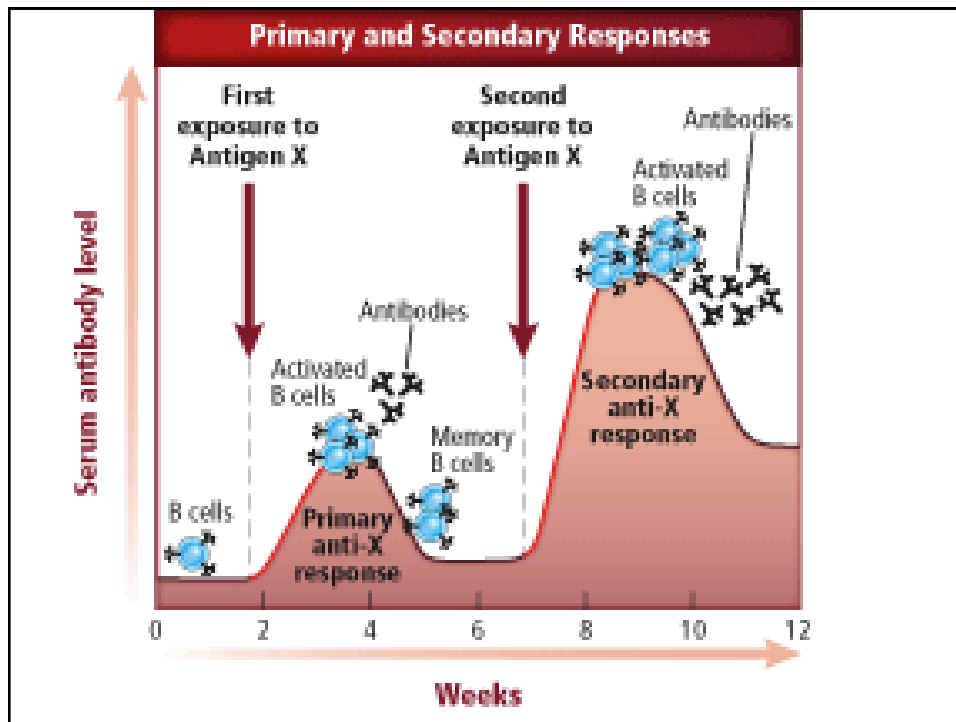


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2 Types of Specific Immunity

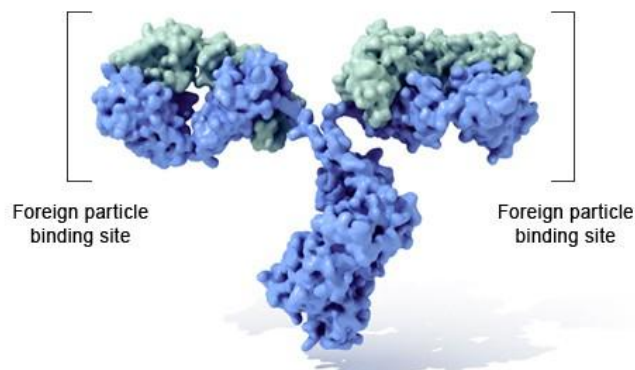
- 2. Humoral Response
 - B cells (White Blood Cell type!)
 - Produce Antibodies & memory B cells
 - Antibodies specific to each different antigen!
 - Protein markers (Immunoglobulins)
 - Second exposure to same antigen results in a more rapid and enhanced immune response because memory B cells are ready!



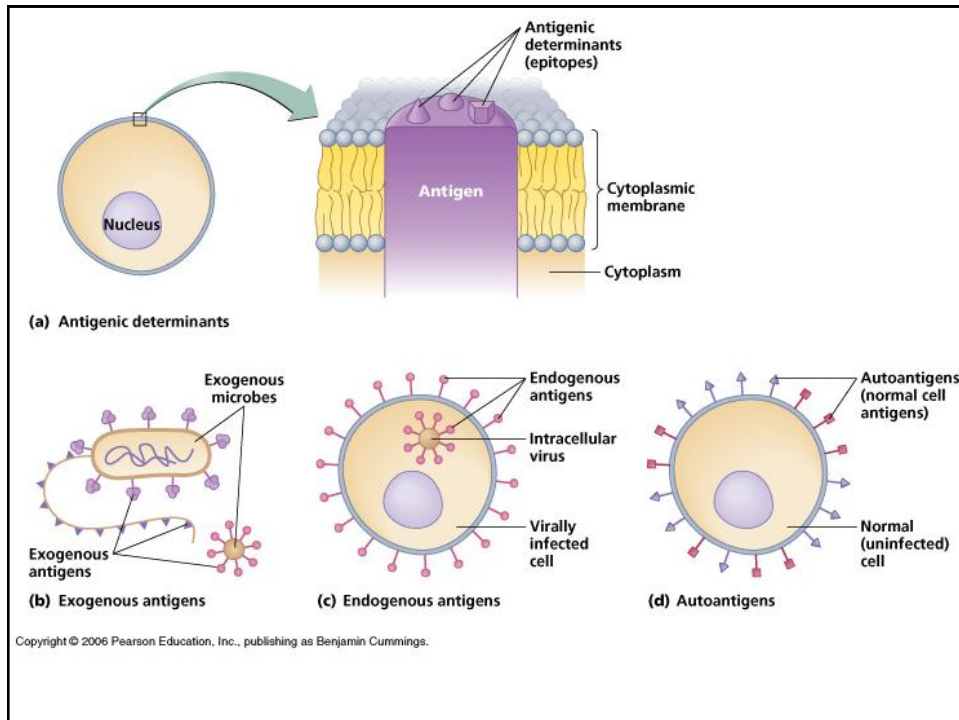


- Antibodies are proteins, hence the vast number of possible types.

Immunoglobulin G (IgG)



U.S. National Library of Medicine

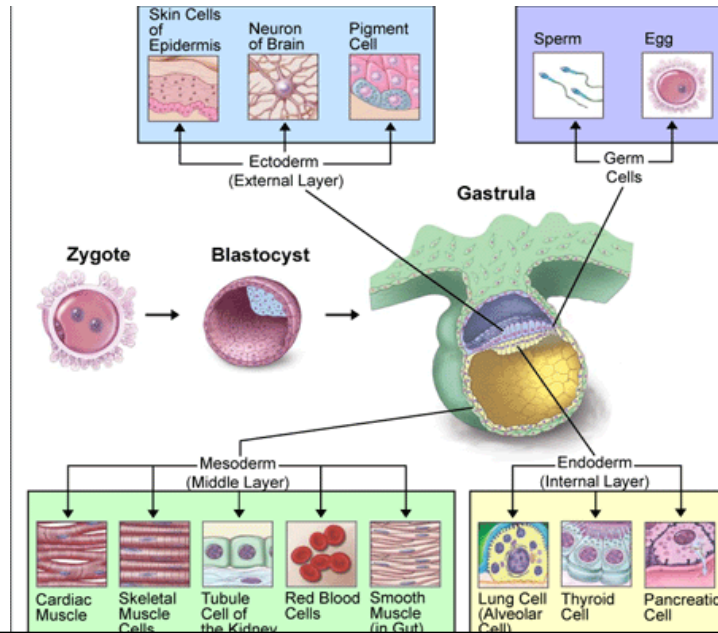


Regulation Mechanisms

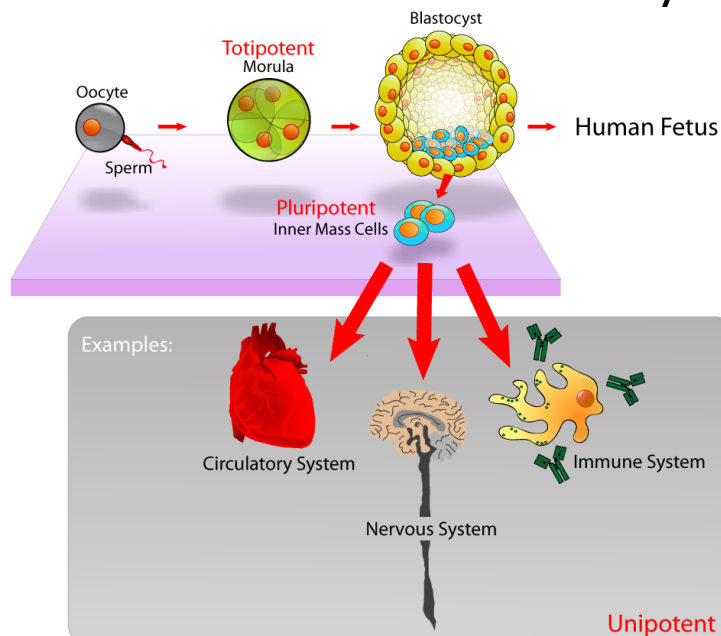
- Timing & coordination of responses are **regulated** by various mechanisms.



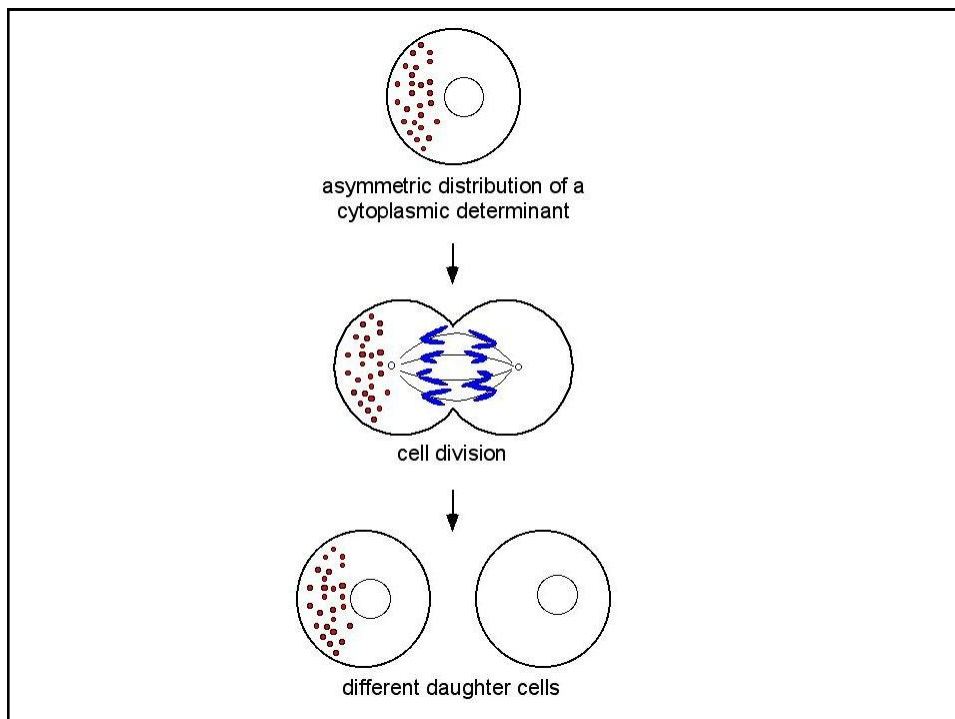
1. Organism Development

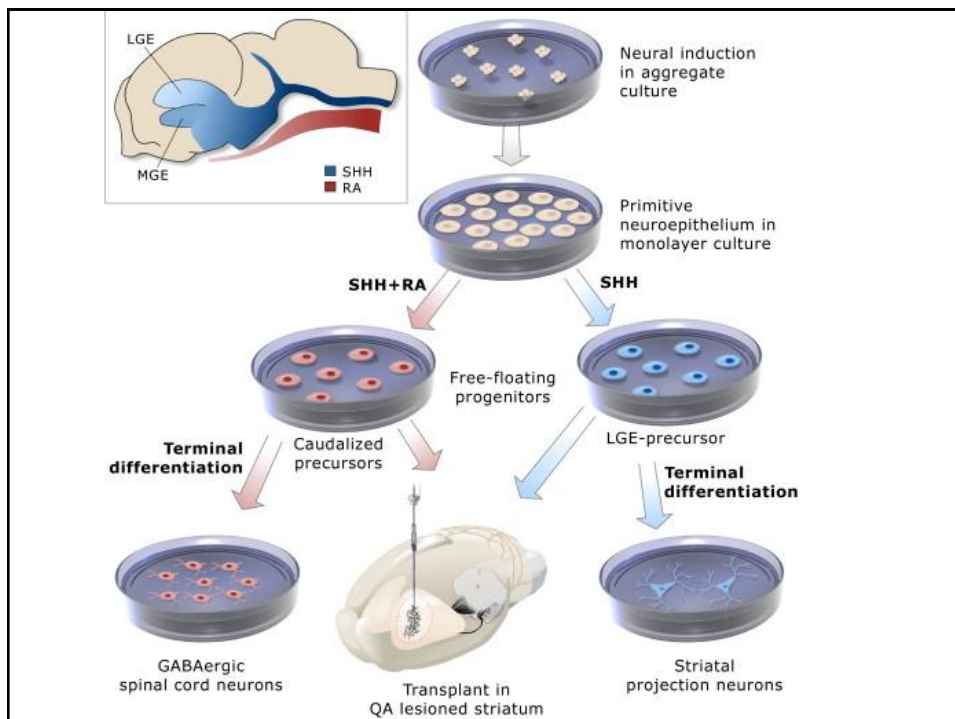
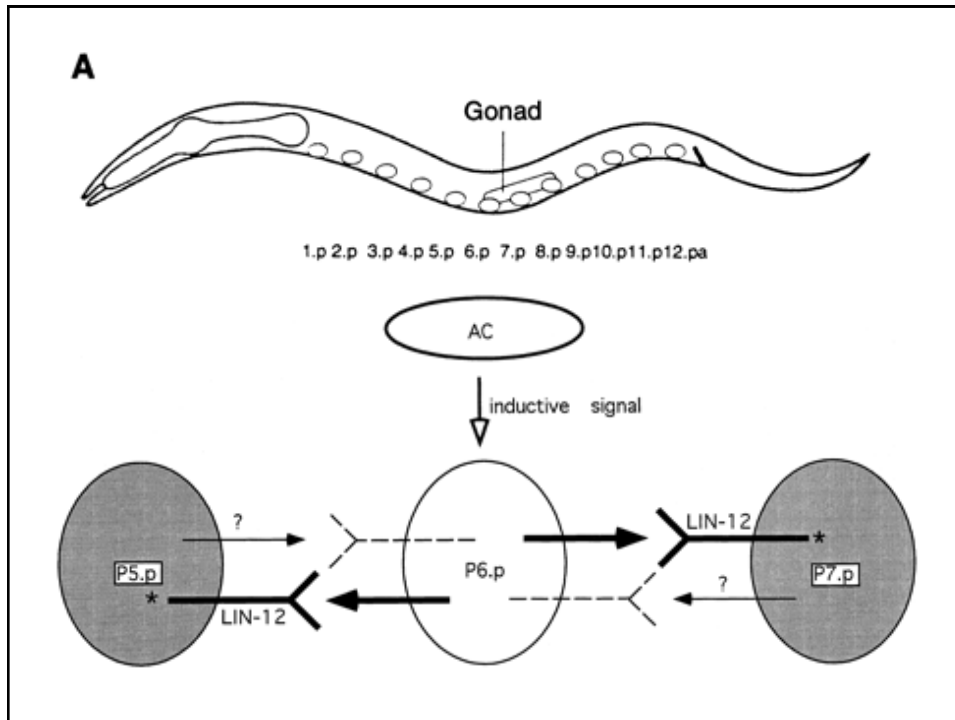


Determination-"Potency"



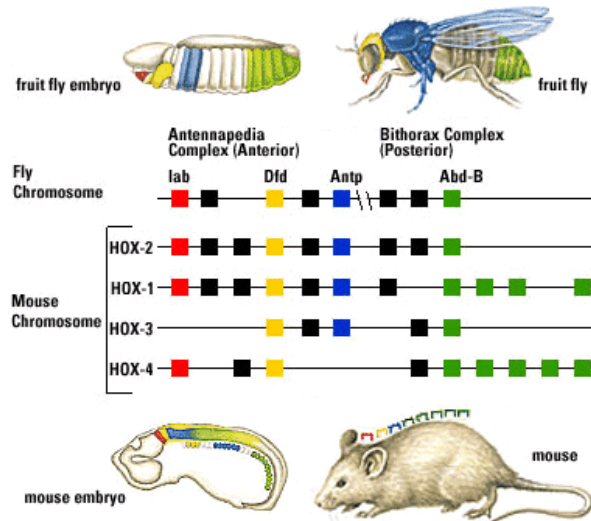
- ALL cells (except immune) have a complete set of instructions (DNA!).
- Why do they end up looking ***different***???
 - Blood cells Nerve cells Skin cells
- The DNA is ***expressed differentially!***
- Regulators:
 - Transcription Factors Inductive signals





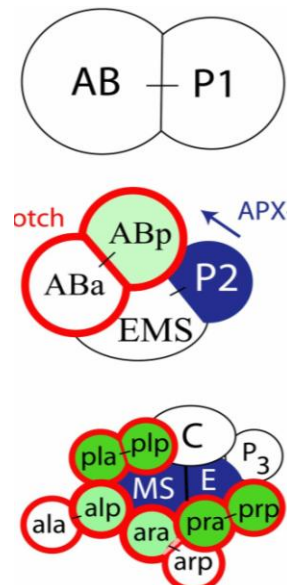
Homeotic (HOX) Genes

- Developmental Patterns & Sequences
- Body Plan
- Small mutations are **LETHAL**
- Common to most animals...support for evolution & common ancestry



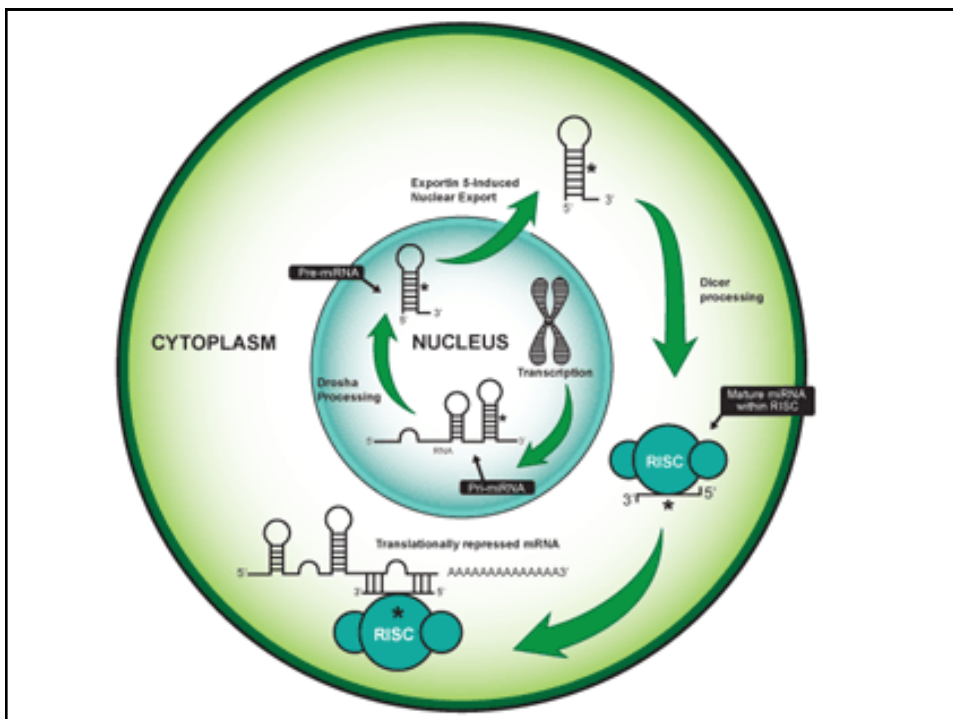
Induction & Coordination of Events

- P_1 division asymmetric; produces EMS and P_2 that express distinct sets of proteins.
- AB division symmetric; Produces ABa and ABp; initially equivalent.
- However, the posterior displacement of ABp puts it in contact with the P_2 cell; thus some genes are activated in ABp, but **not** in ABa.
- Likewise, some genes expressed in ABa due to contact with EMS.



miRNA

- MicroRNAs extremely important during development.
- Embryonic stem cells that do not form miRNAs fail to differentiate in vitro and in vivo.
- Regulate gene expression by either **degrading** mRNAs or **blocking** their translation.
- Why would **degrading/blocking** protein production be important during development???



Mandatory Death!

- **Apoptosis**: Programmed cell death
- Normal development of the fingers and toes depends on death of the cells forming webs between them.
- In carnations, ethylene produced from the pollinated stigma is translocated, via the style and ovary, to the petals. Here it up-regulates ethylene biosynthetic genes and induces the production of ethylene in the petals. This ultimately leads to death of the flowers.

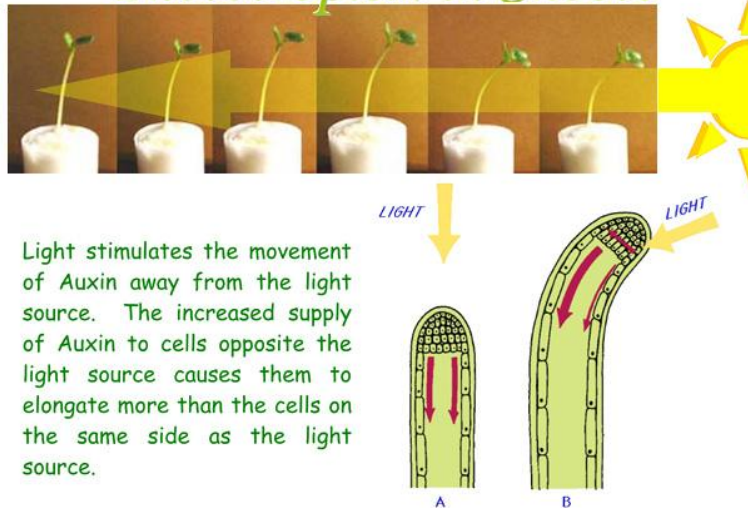
Research Assignment

- Research the various experiments & findings of historical embryological studies.
- In a brief written essay **justify the claim that timing & coordination are important to normal development** based on your research findings. As an extension, address whether or not human studies should be conducted and why.

2. Physiological Responses

- Plants
- Interactions between environmental stimuli and internal molecular signals.
- **Phototropism**: response to light
- **Photoperiodism**: response to change in length of night: flowering of short/long-day plants
- Based on **plant hormones** triggered by light/water/gravity/attack by predators

Phototropism in Shoots



Photoperiodism

- Amount of **darkness** triggers photoreceptor cells, which trigger flowering.
- Long day plants- less darkness (longer days) triggers flowering.
 - Carnations, Oats, Clover
- Short day plants – more darkness (shorter days) trigger flowering.
 - Strawberry, Poinsettia, Coffee

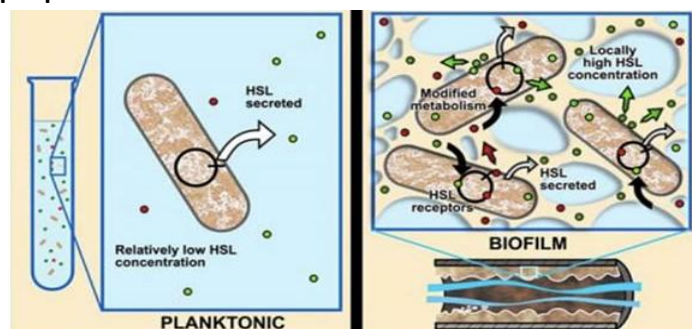
- Develop a plan to test the previous two examples of plant responses.
- Address how they can be tested as being important to natural selection.

2. Physiological Responses

- Animals
- Internal & external signals regulate a variety of physiological responses that synchronize with environmental cycles & cues.
 - Circadian rhythms, Jet lag, aggressiveness in males during reproductive cycles

2. Physiological Responses

- Bacteria
- **Quorum** sensing to coordinate certain behaviors based on the local density of the bacterial population



2. Physiological Responses

- Fungi
- Fruiting body formation in response to nutrients available.



Behaviors

- Timing & coordination of behavior are regulated by various mechanisms and are important in natural selection.

Inherited vs. Learned

- Learned behavior – occurs through interactions with the environment and other organisms
 - Prey selection
 - Community Ranks
- Innate behavior – inherited
 - Crying baby
 - Animal courtship (birds, insects)

Coyote vs. Porcupine...OUCH!!!



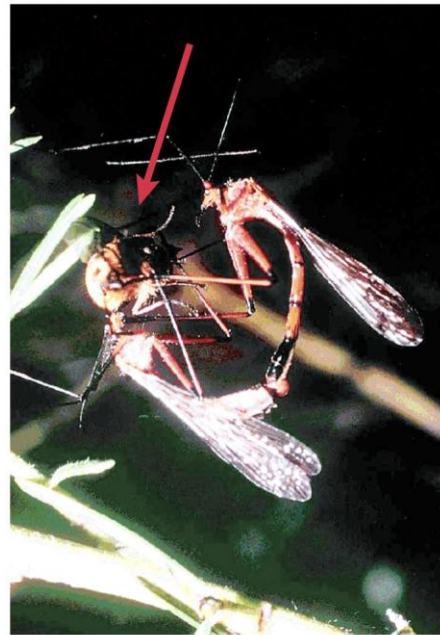
Hanging Flies

Males give a nuptial gift prior to mating.

In "primitive" species, the nuptial gift is an item of **prey**.

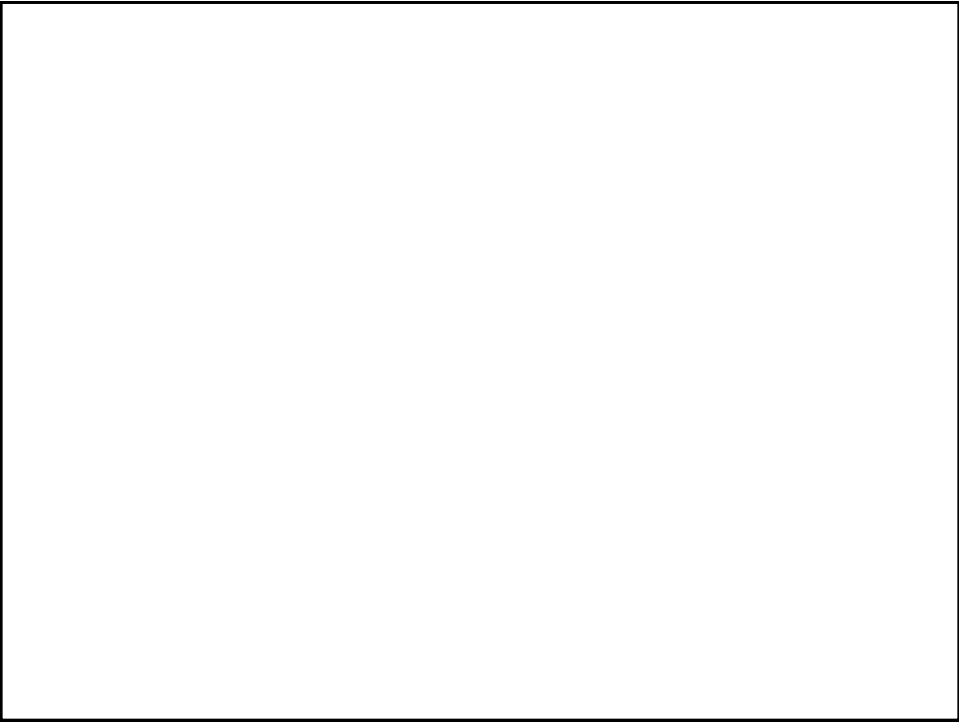
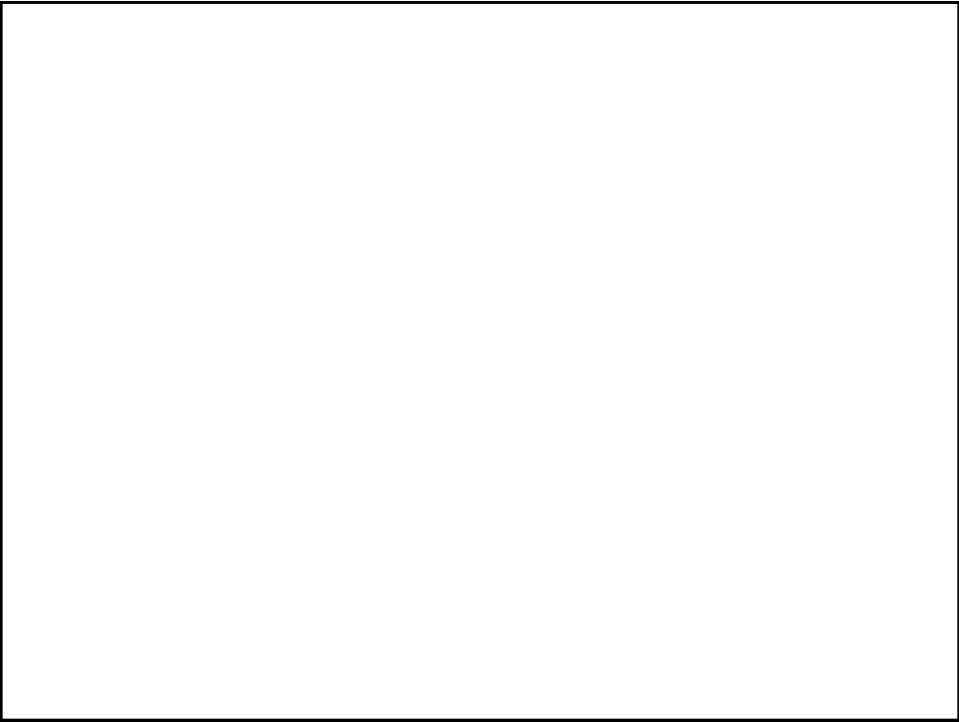
In more "advanced" species, males wrap the prey in silk.

In other species, males offer just a ball of silk.



Evolution, 1/e Figure 17.4
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- Using the previous example with hanging flies...
- Predict the various female responses to each "gift".
- Analyze the males' strategies in each scenario as related to natural selection.
- Are these innate or learned behaviors? Justify your response.



Cooperativity

- Cooperation within or between populations contributes to the survival of the populations.
 - Mutualistic bacteria with animals
 - Pollination: animals & plants
 - Lichens: Algae & Fungi

